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(54) Safety locking devices for doors of washing machines and the like

(57) A safety locking device with delayed re-opening for doors of washing machines and the like, including an apertured slide (11) to be locked in position and comprising a casing (6) closed by a cover (12) and containing a first terminal (1), a second terminal (2) and a third terminal (3), wherein the electric connection between the first terminal (1) and the third terminal (3) is made through a movable arm (7) mounted upon the first terminal (1) and bearing a slide locking paw (14) firmly attached thereto; an actuation assembly for the movable arm (14) is interposed between the first terminal (1) and the second terminal (2), said actuation assembly consisting of a bimetal strip (5) and of a heating tablet (4), the stroke of the movable arm (7) being determined by a stop tooth element (D) provided in the casing and by a stationary contact element (9) attached to the third terminal (3). The assembling and mounting and the position interrelationship of the actuation assembly (5, 4) in the casing, are effected by means of a first tooth (A) and optionally a second tooth (B) provided on the first terminal and a third tooth (C) provided on said movable arm (7) as well as by means of either a deformed portion of the second terminal (2) or a spring supported by the second terminal (2).

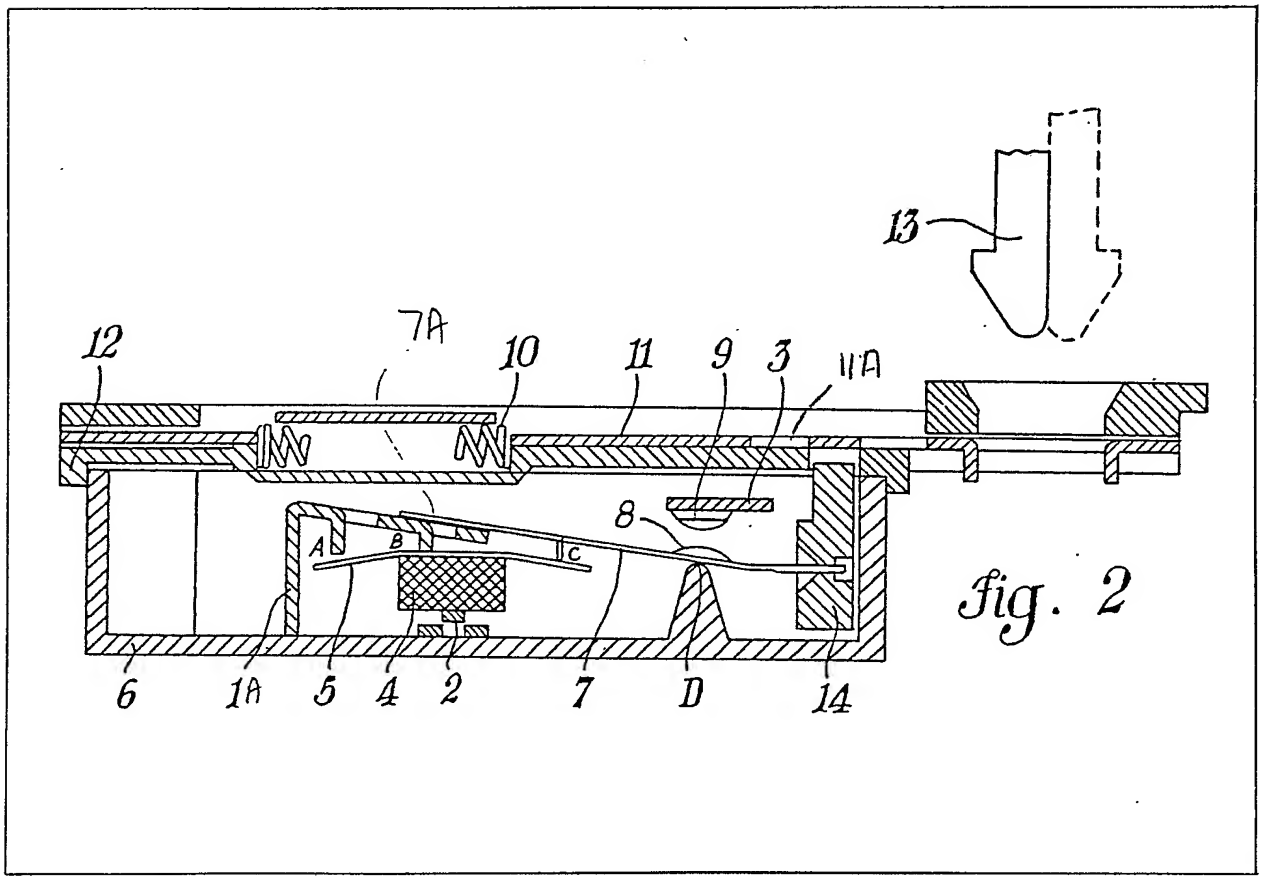

fig. 2

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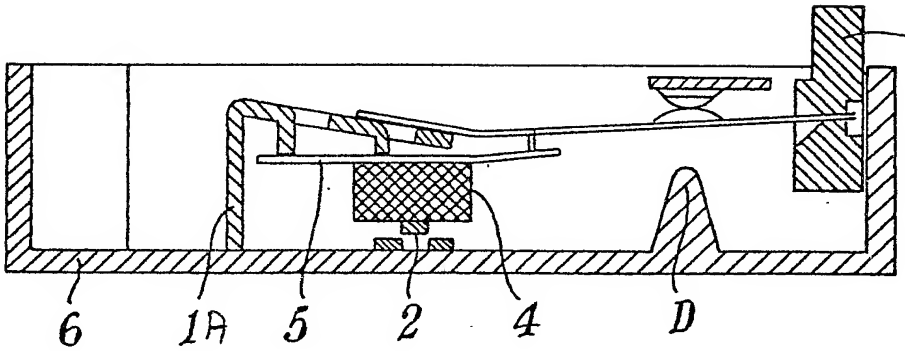
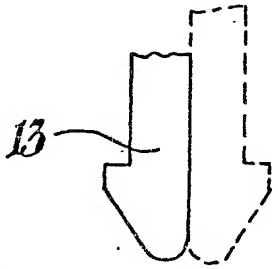


Fig. 1



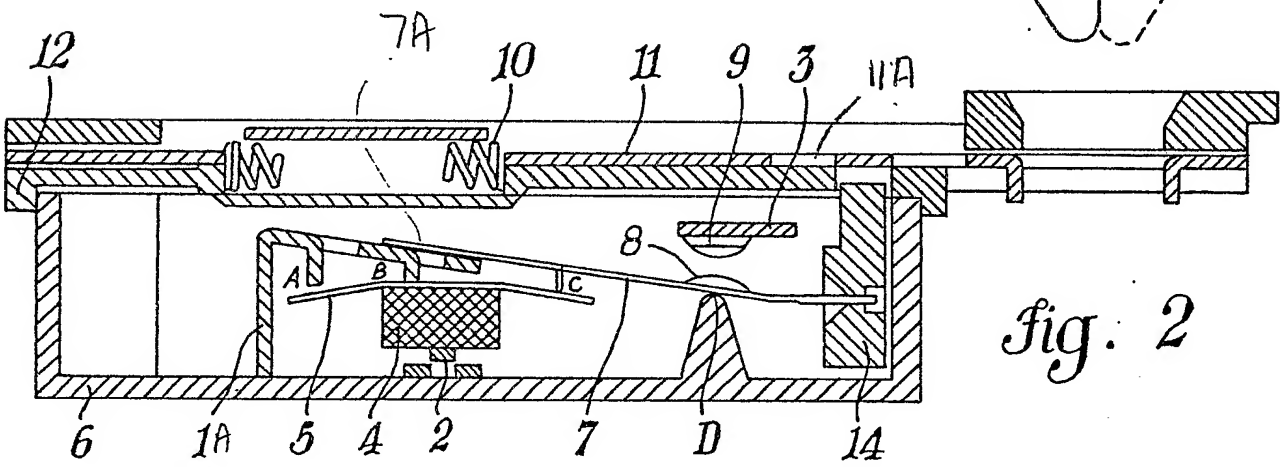


Fig. 2

Fig. 4

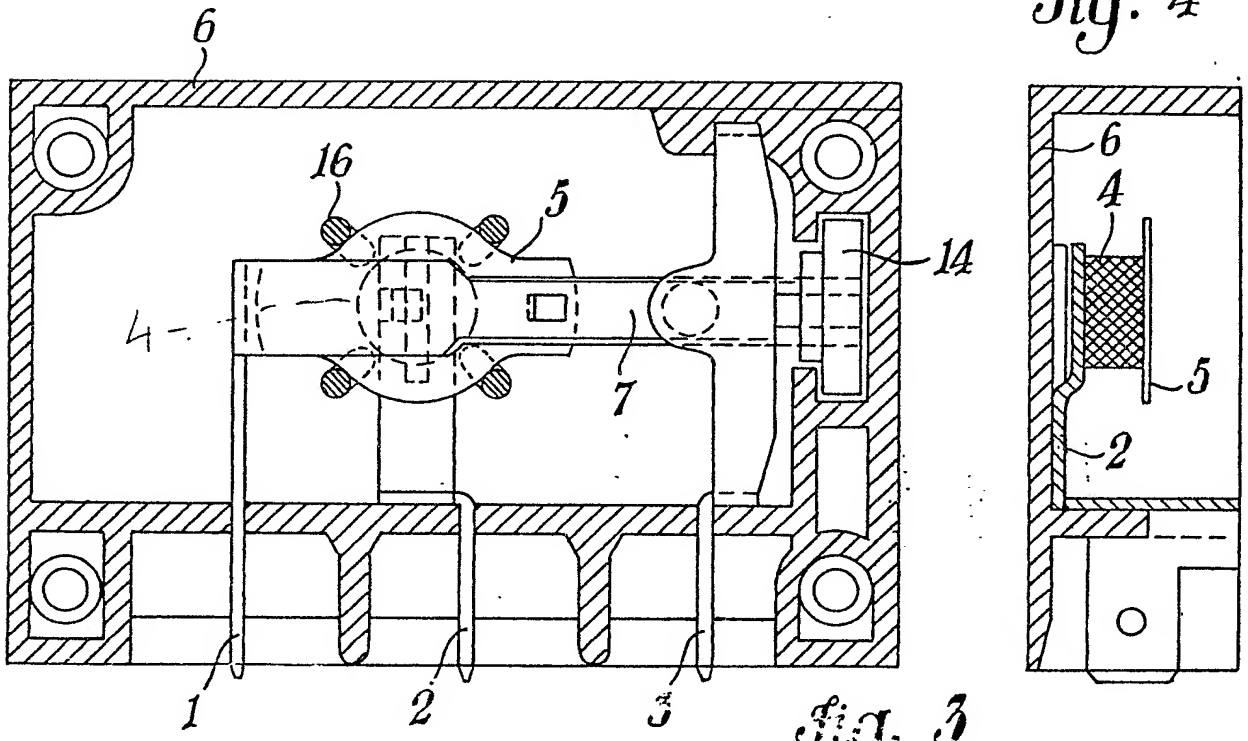


Fig. 3

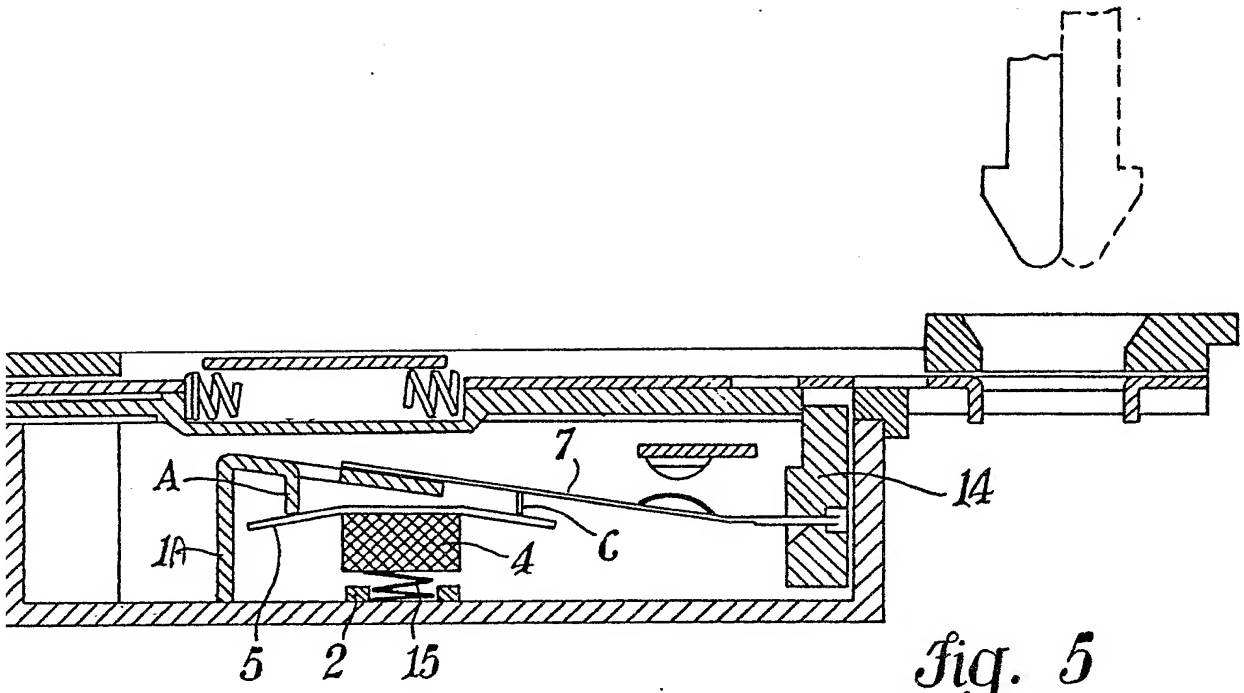


Fig. 5

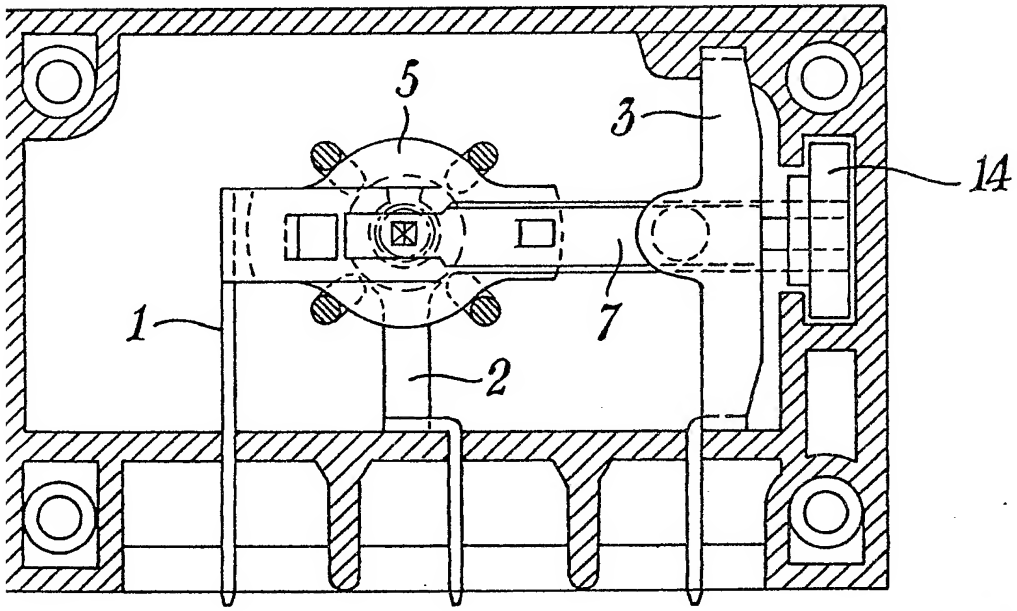


Fig. 6

SPECIFICATION

Safety locking devices for doors of washing machines and the like

The invention relates to a safety locking device for doors of cloths washing machines, dish washing machines and the like, and an object of the invention is to provide such a device having a simplified structure, and improved reliability, operation safety and/or life duration.

The problem underlying this invention is known: a safety locking is to be provided for the doors of domestic appliances of the kind having a rotary member, such as cloths washing machines, dish washing machines and the like, such that the closed condition of the door when the appliance is in operation is ensured and the door can only be opened when a sufficient time period has elapsed after the ending of an operation of the appliance for the rotating mass to reach a rest condition.

Various approaches are known from the prior art wherein a bimetal strip is heated by means of a current flow. The approaches of the prior art, however, have disadvantages and deficiencies, which this innovation aims at eliminating.

The main object of this invention is, therefore, to provide a door-locking device having an electrically-heated bimetal strip, the device having an extremely simplified, highly reliable structure, and consisting of a minimum number of parts.

According to the present invention there is provided a safety locking device for the door of a washing machine or the like, including an apertured locking slide to be locked by means of a retractible locking bolt in a position locking the door, and further comprising a casing with first, second and third electrical terminals, electrical connection between the first and third terminals being controlled by a movable arm mounted on the first terminal and carrying the slide locking bolt, the actuating stroke of the movable arm being limited in the one direction by a stop in the casing and in the other direction by a fixed switch contact carried by the third terminal; and further including an actuating assembly for the movable arm, the actuating assembly comprising a bimetal strip and a heating tablet therefor, the actuating assembly being held assembled in the casing and its positional interrelationship effected by means of at least one fixed tooth provided on the first terminal and a further tooth provided on the movable arm, and by means of a portion of the second terminal or a member supported thereby.

Preferably, the heating tablet is composed of a material having a positive coefficient of electrical resistivity with temperative (PTC material), and heating current is passed through the tablet between the first and second terminals.

It is a further object of this invention to provide a door-locking device wherein a bimetal strip, which is heated by direct contact with a heating tablet, is engaged therewith with a noticeable clamping force, thereby improving the termal coupling between the said two concerned components. A minimum value of 500 grs for this clamping force is quoted by way of example.

This may be achieved in one form of the invention, in which there are first and second fixed teeth provided on the first terminal which coact respectively with two longitudinally-spaced regions of the outer face of the bimetal strip, the said further tooth carried by the movable arm co-acting with the outer face of an end portion of the bimetal strip remote from the two fixed teeth, and in which a deformed portion of the second terminal is engaged with the heating tablet.

Thus the actuating assembly in such an arrangement may be gripped as a forced fit between on the one side that one of the two fixed teeth which lies between the other fixed tooth and the said further tooth carried by the movable arm, and on the other side the deformed portion of the second terminal, the deformation of the second terminal determining the degree of the forced fit and being adapted to provide a good thermal coupling between the bimetal strip and the heating tablet.

In such a case the path for heating current for the tablet may be between the said one fixed tooth on the first terminal and the second terminal, via the heating tablet and the bimetal strip.

An advantage resulting from this improved thermal coupling is that, under the same conditions of snap temperature of the bimetal strip, mass of the PTC material tablet and Curie temperature thereof, the snap temperature of the bimetal strip is rapidly, or more rapidly reached.

The bimetal strip as employed in this invention may be of a pre-formed type, so as to have well defined temperatures for curvature inversions and therefore rapid snap inversions.

In a preferred embodiment of this invention, the assembling of the PTC material tablet to its contact terminal, the said second terminal, is carried out by deforming the latter so that all manufacturing tolerances of the tablet are accommodated and any calibration step aiming at restricting the activation and reset times within the desired limits may become unnecessary.

The invention from another aspect, however, comprises a safety locking device for the door of a washing machine or the like, the device including an apertured locking slide to be locked by means of a retractible locking bolt in a position locking the door, and further comprising a casing with first, second and third electrical terminals, electrical connection between the first and third terminals being controlled by a movable arm mounted upon the first terminal and carrying the slide locking bolt; and further including an actuating assembly for the movable arm interposed between the first and second terminals, the actuating assembly comprising a pre-formed bimetal strip of curvature-inversion type and a heating tablet therefore of a material having a positive co-efficient of electrical resistivity with temperature, and the actuating assembly being held assembled in the casing and its positional interrelationship determined by means of a tooth

provided on the first terminal, a second tooth provided on the movable arm, and a spring acting between the heating tablet and the second terminal.

In this case the heating tablet is preferably heated by electric current passing between the first and second terminals via the tooth on the first terminal, the bimetal strip, the tablet and the spring.

The invention may be carried into practice in various ways but two specific embodiments thereof will now be described by way of example only and with reference to the accompanying drawings, in which the specific embodiments are shown by way of illustration and not of limitation, and in which:

Figure 1 is a diagrammatic sectional view showing main components of a first embodiment of locking devices for e.g. a domestic washing machine, shown in locking position;

Figure 2 is a more detailed sectional view showing the device of Figure 4 in unlocked position;

Figure 3 is a plan view of the device;

Figure 4 is a cross-section of the device taken along a line passing through the heating tablet;

Figure 5 is a sectional view of the device, in a second embodiment having the tablet assembled by means of a spring; and

Figure 6 is a plan view of the device as shown in Figure 5.

Referring now to Figure 1 and particularly to Figures 2 and 3, it can be seen that the door-locking device includes a casing 6 closed by a cover 12, and containing three electric connection terminals 1, 2 and 3. In use, terminal 1 is directly connected to one of the two lines of a single-phase mains supply e.g. 220 volts 60 hz, from which the associated washing or other machine is to be driven. Terminal 3 is connected through the electrical driving motor circuiting of the machine to the second line of the mains. Terminal 2 is connected to the second line of the mains and is not directly involved in the energisation of the machine itself, but completes the heating circuit for the tablet. The parts of the device that are already known, such as the apertured slide 11 loaded by a spring 10 and the closure catch 13, will not be further described: it will be sufficient to specify that the side 11 is spring-loaded by spring 10 to the unlocked position of Figure 2, but when moved to the right (or left) in Figure 2 to its door locking position it engages behind the abutment shoulder of the inserted catch 13 to prevent retraction of the catch and opening of the door; and that the function of the device is to lock the slide 11 in its door-locking position by pushing a bolt 14 into its aperture.

Terminal 1 includes a post 1A bearing an electrically-conducting resiliently-flexible movable arm 7 firmly attached at one end 7A thereto, the arm acting as a restrained beam and carrying at its other end a contact pad 8. In operative position, contact pad 8 is engaged with a stationary contact pad 9 fixed to electric connection terminal 3, to supply power to an associated driving motor in the rotary part of the machine. A bimetal strip 5 which is preformed to a generally upwardly bowed shape with a plane intermediate portion in its de-activated (cool) state as shown in Figure 2, is mounted with its said plane portion clamped onto a cylindrical heating tablet 4 of a material having a positive coefficient of electrical resistivity with temperature (PTC) material, in contact engagement with the second terminal 2. As it can be observed in the figures, terminal 2 is longitudinally split in the engagement area with tablet 4 so as to provide a force fit, i.e. a clamping engagement with the tablet 4. Such a force fit against the small tooth B provided on terminal 1 is intended to optimise the thermal coupling between the bimetal strip 5 and the tablet 4 and to accommodate the manufacturing tolerances of the tablet itself. The tablet 4 is electrically heated, its heating current passing through the strip 5 and the material of the tablet 4 between tooth B of terminal post 1A and terminal 2.

Small teeth A and C provided upon terminal post 1A and upon the flexible arm, 7, respectively, are intended to establish positional interrelationships with respect to the bimetal strip 5, so as to ensure as good as possible values of the activation and deactivation times, as it will be better explained hereinafter.

Furthermore, a stop tooth element D is provided on the base of casing 6 and this stop tooth element D together with the fixed contact pad 9 determines the stroke of the flexible arm 7.

As it can be seen in Figure 3, the bimetal strip 5 is laterally located in its place by means of four upwardly-extending pins 16.

The device operates as follows.

Upon closing a power supply circuit in which the connection terminals 1, 2 and 3 are connected as indicated above, the tablet 4 warms up according to the well-known positive slope curve as heating current passes through it between terminals 1 and 2.

The pre-formed bimetal strip 5 in physical contact with the tablet 4 warms up to its intervention temperature at which the inner stresses caused by the different thermal expansion coefficients take on valves that become equal to and then higher, considered as absolute values, than the pre-existent stresses caused by preforming. The bimetal strip curvature immediately changes its sign and the bimetal strip pushes against tooth C and bends the movable arm 7 upwardly with points A and B acting as fulcrum points as shown in Figure 1. Thus, contacts 8 and 9 are closed to energise the driving motor of the rotating mass, and bolt 14 is displaced so as to enter the aperture 11A in slide 11, thereby acting as a mechanical locking member for the slide 11 in its door-locking position.

The bimetal strip forming is such that a well defined actuating (intervention) temperature which is higher than the reset temperature is established; this difference accounts for the fact

that the curvature inversion takes place with a snap type action, which is advantageous to the life duration of the electric contact element.

When the power supply circuit is opened, thereby discontinuing the heat generation by the tablet, the system cools down and also the bimetal strip cools down and then returns to its deactivated position, this action being more or less facilitated according to the intrinsic higher or lower stiffness of the movable arm 7.

As said above, a good thermal coupling between the tablet 4 and the bimetal strip 5 is ensured by the noticeable force by which the mains connection terminal post 1A clamps the bimetal strip against the tablet by the tooth B. This force is generated as a result of the deformation to which the split terminal strip 2 is subjected on assembling in order to accommodate the relevant dimentional tolerances of the PTC material member 4. In view of this optimum thermal coupling, the intervention (actuation) time of the bimetal strip is very short, whereby the operator of the machine, just upon actuating the power-up control of the machine, immediately receives a reassuring indicating of a perfect operation.

The mains connection terminal post 1A having a suitable rigidity ensures that points A, B and C always lie at reproducible heights giving mass production uniformity, and this, together with the fixed position of stop tooth element D, provides the mechanism with the desired intervention and reset time constancy. In fact, the stroke of the movable arm 7 and also the reaction force it will exert upon bimetal strip 5 in the return step will be dependant on the heights of points C and D. Moreover, fixed point A resists the bimetal strip curvature in the activated position (Fig. 1) and the less the distance of this point from the bimetal strip 5 in rest condition (Fig. 2) the more the return to its rest position is facilitated. The return times can be additionally reduced when this distance is annulled or even when the engagement between point A and bimetal strip is initially effected as an interference fit. This initial arrangement is not prejudicial either to the intervention time or to the snap action of the bimetal strip to its activated position, in view of the good thermal coupling and of the unique position of point B with respect to the bimetal strip, by which the effect of point A is compensated.

The position of point B of course should be in the plane portion of the bimetal strip, not to be prejudicial to the snap action and to ensure the thermal coupling with the tablet.

It has been found that increasing the lengths of teeth A and C extends the intervention delay time (after switching on) and reduces the reset delay time (after switching off); in particular, however, the length of tooth A affects the reset time more than the intervention time.

In conclusion, the heights of points A, B, C and D as designed determine, when the other conditions are the same, a more or less rapid reset time of the device from its activated position to its rest position, even if the intervention delay time remains in the expected range (1—2 seconds).

Since the heights of the four points A, B, C and D are highly reproducible the effects of the component parts tolerances and in particular the tablet tolerances are almost annulled, so that any calibration operation aimed at maintaining the intervention and rest times within the desired limits become superfluous.

The effective safety of this device is obtained as a direct consequence of its operation logic; in fact, when the bolt 14 falls to displace to its operative position, due to any incidental or intentional reason, the possibility to close contacts 8 and 9 and energise the rotation motor is excluded.

Two different views of another embodiment of this innovation are shown in Figures 5 and 6. In this embodiment, the delicate task of ensuring the electric connection to the tablet 4 and its thermal coupling with the bimetal strip 5 is allocated to a compression spring element 15. Furthermore, it can be seen that the line connection terminal 1 has no tooth B as in the embodiment shown in Figures 1—4. All other structural elements are identical.

Any need of a calibration operation is excluded in this embodiment, as well, in view of the presence of spring 15, the elastic features of which are such as to accommodate all possible height tolerances of the component parts, the bimetal strip 5 being never unduly pre-stressed.

CLAIMS

1. A safety locking device for the door of a washing machine or the like, the device including an apertured locking slide to be locked by means of a retractible locking bolt in a position locking the door, and further comprising a casing with first, second and third electrical terminals, electrical connection between the first and third terminals being controlled by a movable arm mounted on the first terminal and carrying the slide locking bolt, the actuating stroke of the movable arm being limited in the one direction by a stop in the casing and in the other direction by a fixed switch contact carried by the third terminal; and further including an actuating assembly for the movable arm, the actuating assembly comprising a bimetal strip and a heating tablet therefor, the actuating assembly being held assembled in the casing and its positional inter-relationship effected by means of at least one fixed tooth provided on the first terminal and a further tooth provided on the movable arm and by means of a portion of the second terminal or a member supported thereby.

2. A safety locking device according to Claim 1, in which there are first and second fixed teeth provided on the first terminal which co-act respectively with two longitudinally-spaced regions of the outer face of the bimetal strip, the said further tooth carried by the movable arm co-acting with the outer face of an end portion of the bimetal strip remote from the two fixed teeth, and in which a deformed portion of the second terminal engaged with the heating tablet.

3. A safety locking device according to Claim 2, in which the movable arm is resilient and is firmly mounted on the first terminal so as to act as a restrained beam, the spring constant of which as computed in relation to the third tooth, is a critical factor in the required operation of the device itself, the resilient arm carrying a movable switch contact which co-operates with the fixed contact on the third terminal.

4. A safety locking device as claimed in Claim 2 or Claim 3, in which the actuating assembly is gripped as a forced fit between on the one side that one of the two fixed teeth which lies between the other fixed tooths and the said further tooth carried by the movable arm, and on the other side the deformed portion of the second terminal, the deformation of the second terminal determining the degree of the forced fit and being adapted to provide a good thermal coupling between the bimetal strip and the heating tablet.

5. A safety locking device as claimed in any one of Claims 1 to 4, in which the heating tablet is composed of a material having a positive temperature co-efficient (PTC).

6. A safety locking device as claimed in any one of the preceding claims, in which the bimetal strip is of a preformed, curvature-inversion type.

7. A safety locking device as claimed in Claims 2 and 6, in which the bimetal strip when heated by the heater tablet to pass through its curvature inversion pushes against the tooth carried by the movable arm to displace the arm into its slide locking position, and in which the fixed tooth on the first terminal which is furthest from the tooth carried by the movable arm is so dimensioned that when curvature inversion of the bimetal strip takes place that fixed tooth is engaged by the bimetal strip and acts as a fulcrum for the strip to displace the movable arm.

8. A safety lock as claimed in Claim 1, in which only a single fixed tooth is provided on the first terminal, and in which the actuating assembly is pressed resiliently against that tooth and the tooth carried by the movable arm by means of a spring supported by the second terminal and bearing against the actuating assembly.

9. A safety locking device for the door of a washing machine or the like, the device including an apertured locking slide to be locked by means of a retractible locking bolt in a position locking the door, and further comprising a casing with first, second and third electrical terminals, electrical connection between the first and third terminals being controlled by a movable arm mounted upon the first terminal and carrying the slide locking bolt; and further including an actuating assembly for the movable arm interposed between the first and second terminals, the actuating assembly comprising a preformed bimetal strip of curvature-inversion type and a heating tablet therefore of a material having a positive temperature co-efficient, and the actuating assembly being held assembled in the casing and its positional interrelationship determined by means of a first tooth provided on the first terminal, a second tooth provided on the movable arm and a compression spring acting between the heating tablet and the second terminal.

10. A safety locking device for the door of a washing machine or the like, substantially as specifically described herein by way of example and with reference to Figures 1 to 4 or to Figures 5 and 6 of the accompanying drawings.

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ABSTRACT:

CHG DATE=19990617 STATUS=O> A safety locking device with delayed re-opening for doors of washing machines and the like, including an apertured slide (11) to be locked in position and comprising a casing (6) closed by a cover (12) and containing a first terminal (1), a second terminal (2) and a third terminal (3), wherein the electric connection between the first terminal (1) and the third terminal (3) is made through a movable arm (7) mounted upon the first terminal (1) and bearing a slide locking paw (14) firmly attached thereto; an actuation assembly for the movable arm (14) is interposed between the first terminal (1) and the second terminal (2), said actuation assembly consisting of a bimetal strip (5) and of a heating tablet (4), the stroke of the movable arm (7) being determined by a stop tooth element (D) provided in the casing and by a stationary contact element (9) attached to the third terminal (3). The assembling and mounting and the position interrelationship of the actuation assembly (5, 4) in the casing, are effected by means of a first tooth (A) and optionally a second tooth (B) provided on the first terminal and a third tooth (C) provided on said movable arm (7) as well as by means of either a deformed portion of the second terminal (2) or a spring supported by the second terminal (2). □